

Patent claims

1. Ceramic material composed of

- a first ceramic material with a perovskite structure as the host lattice, containing

5 lead, zirconium and titanium and

- a second ceramic material with a cryolite structure.

2. Ceramic material per claim 1,

in which the first and the second material form a mixed crystal phase.

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3. Ceramic material per one of claims 1 or 2,

in which the second ceramic material has the general formula

$[A_4(Br_{2-2x/3}Nb_{2+2x/3})O_{11+x}V_{1-x}]$, where A stands for barium or strontium and B for

strontium or calcium and V for an oxygen vacancy and where we have for the parameter

15 $x: 0 \leq x \leq 1$.

4. Ceramic material per one of claims 1 or 2,

in which the second ceramic material has the summary formula

$[Sr_4(Sr_{2-2x/3}Nb_{2+2x/3})O_{11+x}V_{1-x}]$, where V stands for an oxygen vacancy and where we have

20 for the parameter $x: 0 \leq x \leq 1$.

5. Ceramic material per one of claims 1 or 2,

in which the second ceramic material has the summary formula

$\text{Sr}_4(\text{Ca}_{2-2x/3}\text{Nb}_{2+2x/3})\text{O}_{11+x}\text{V}_{1-x}$, where V stands for an oxygen vacancy and where we have for the parameter x: $0 \leq x \leq 1$.

5 6. Ceramic material per one of claims 1 or 2,

in which the second ceramic material has the summary formula

$\text{Sr}_4(\text{Mg}_{2-2x/3}\text{Nb}_{2+2x/3})\text{O}_{11+x}\text{V}_{1-x}$, where V stands for an oxygen vacancy and where we have for the parameter x: $0 \leq x \leq 1$.

10 7. Ceramic material per one of claims 1 or 2,

in which the second ceramic material has the summary formula

$\text{Ba}_4(\text{Sr}_{2-2x/3}\text{Nb}_{2+2x/3})\text{O}_{11+x}\text{V}_{1-x}$, where V stands for an oxygen vacancy and where we have for the parameter x: $0 \leq x \leq 1$.

15 8. Ceramic material per one of claims 1 or 2,

in which the second ceramic material has the summary formula

$\text{Ba}_4(\text{Ca}_{2-2x/3}\text{Nb}_{2+2x/3})\text{O}_{11+x}\text{V}_{1-x}$, where V stands for an oxygen vacancy and where we have for the parameter x: $0 \leq x \leq 1$.

20 9. Ceramic material per one of claims 1 or 2,

in which the second ceramic material has the summary formula

$\text{Ba}_4(\text{Mg}_{2-2x/3}\text{Nb}_{2+2x/3})\text{O}_{11+x}\text{V}_{1-x}$, where V stands for an oxygen vacancy and where we have for the parameter x: $0 \leq x \leq 1$.

10. Ceramic material per one of claims 1 to 9,

5 in which the first ceramic material contains a composition of summary formula $\text{Pb}(\text{Zr}_a\text{Ti}_{1-a})\text{O}_3$, and where we have for a: $0.5 \leq x \leq 0.6$.

11. Ceramic material per one of claims 1 to 10,

10 in which the first ceramic material consists of a mixed crystal phase, which is composed from a PZT ceramic and an added component of the perovskite lattice type.

12. Ceramic material per claim 11,

in which the added component has the summary formula KNbO_3 .

15 13. Ceramic material per claim 11,

in which the added component has the summary formula $\text{Pb}(\text{M}^{\text{II}}_{1/3} \text{M}^{\text{V}}_{2/3})\text{O}_3$ and wherein M^{II} stands for Mg, Zn, Co, Ni, Mn, or Cu and M^{V} for Nb, Ta, or Sb.

14. Ceramic material per claim 11,

20 in which the added component has the summary formula $\text{Pb}(\text{M}^{\text{II}}_{1/2} \text{M}^{\text{VI}}_{1/2})\text{O}_3$ and wherein M^{II} stands for Mg, Zn, Co, Ni, Mn, or Cu and M^{VI} for W.

15. Ceramic material per claim 11,

in which the added component has the summary formula $\text{Pb}(\text{M}^{\text{III}}_{1/2} \text{M}^{\text{V}}_{1/2})\text{O}_3$ and
wherein M^{III} stands for Fe, Mn, Cr, or Ga and M^{V} for Nb, Ta, or Sb.

5 16. Ceramic material per claim 11,

in which the added component has the summary formula $\text{Pb}(\text{M}^{\text{III}}_{2/3} \text{M}^{\text{VI}}_{1/3})\text{O}_3$ and
wherein M^{III} stands for Fe, Mn, Cr, or Ga and M^{VI} for W).

17. Ceramic material per claim 11,

10 in which the added component has the summary formula $\text{Pb}(\text{Li}^{\text{I}}_{1/4} \text{M}^{\text{V}}_{3/4})\text{O}_3$ and
wherein M^{V} stands for Nb, Ta, or Sb.

18. Ceramic material per claim 1 to 17,

in which the ceramic material has the summary formula $\text{A}_{1-b-c}\text{B}_b\text{C}_c$, where: $0 \leq b \leq$
15 0.5 and $0 \leq c \leq 0.01$ and wherein

- A stands for the composition $\text{Pb}(\text{Zr}_a\text{Ti}_{1-a})\text{O}_3$ and $0.5 \leq a \leq 0.6$,
- B stands for an added component of the perovskite lattice type, and
- C stands for a ceramic material of cryolite lattice type.

20 19. Ceramic material per claim 18,

which additionally contains also a PbO excess of up to 3 mol. %.

20. Ceramic material per one of claims 1 to 19,
which is free of KNbO_3 .

5 21. Piezo-actuator

- having a monolithic stack of superimposed piezoelectrical ceramic layers (2) and
electrode layers (3) lying in between, wherein at least one ceramic layer (2) contains a
ceramic material according to one of claims 1 to 19.

10 22. Method for production of a ceramic material per one of claims 1 to 20,
wherein precursor materials of a ceramic material with a cryolite structure are
mixed with precursor materials of a PZT ceramic.

 23. Method for production of a ceramic material per one of claims 1 to 20,
15 wherein a previously prepared cryolite phase is mixed with precursor materials of
a PZT ceramic.